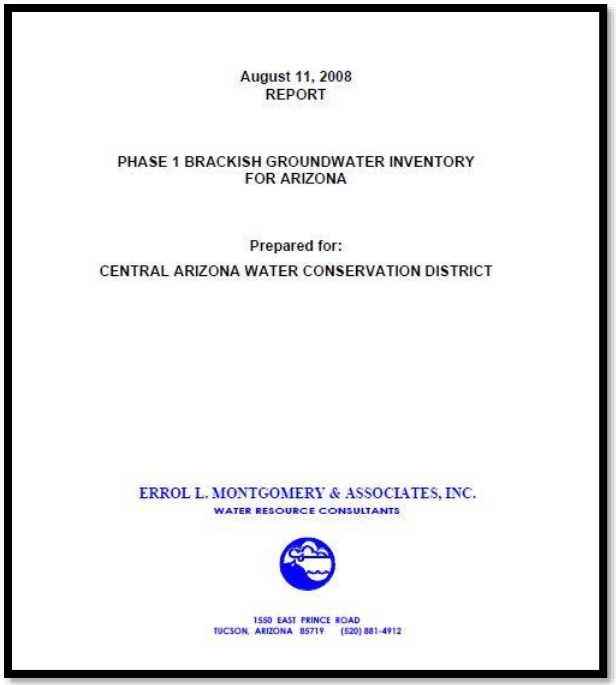
Brackish Groundwater in the Winslow-Leupp Area

Governor's Water Augmentation Council
Desalination Committee Meeting
November 6, 2017

Zacary Richards

Background

* 11,600 AFY for 60 years
  * Offers an alternative water source as opposed to Colorado River water from Lake Powell
* TDS of 1,000 to 5,000 mg/L
* 1,000 AFY of brine
* End user to be Native American Community or Winslow
* $600-$1200 per AF with a 30-year project life
* Water settlement implications
* Unresolved claims of federal reserved rights to groundwater



August 11, 2008
REPORT

PHASE 1 BRACKISH GROUNDWATER INVENTORY
FOR ARIZONA

Prepared for:
CENTRAL ARIZONA WATER CONSERVATION DISTRICT

ERROL L. MONTGOMERY & ASSOCIATES, INC.
WATER RESOURCE CONSULTANTS

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TUCSON, ARIZONA 85719 (520) 881-4912

Background

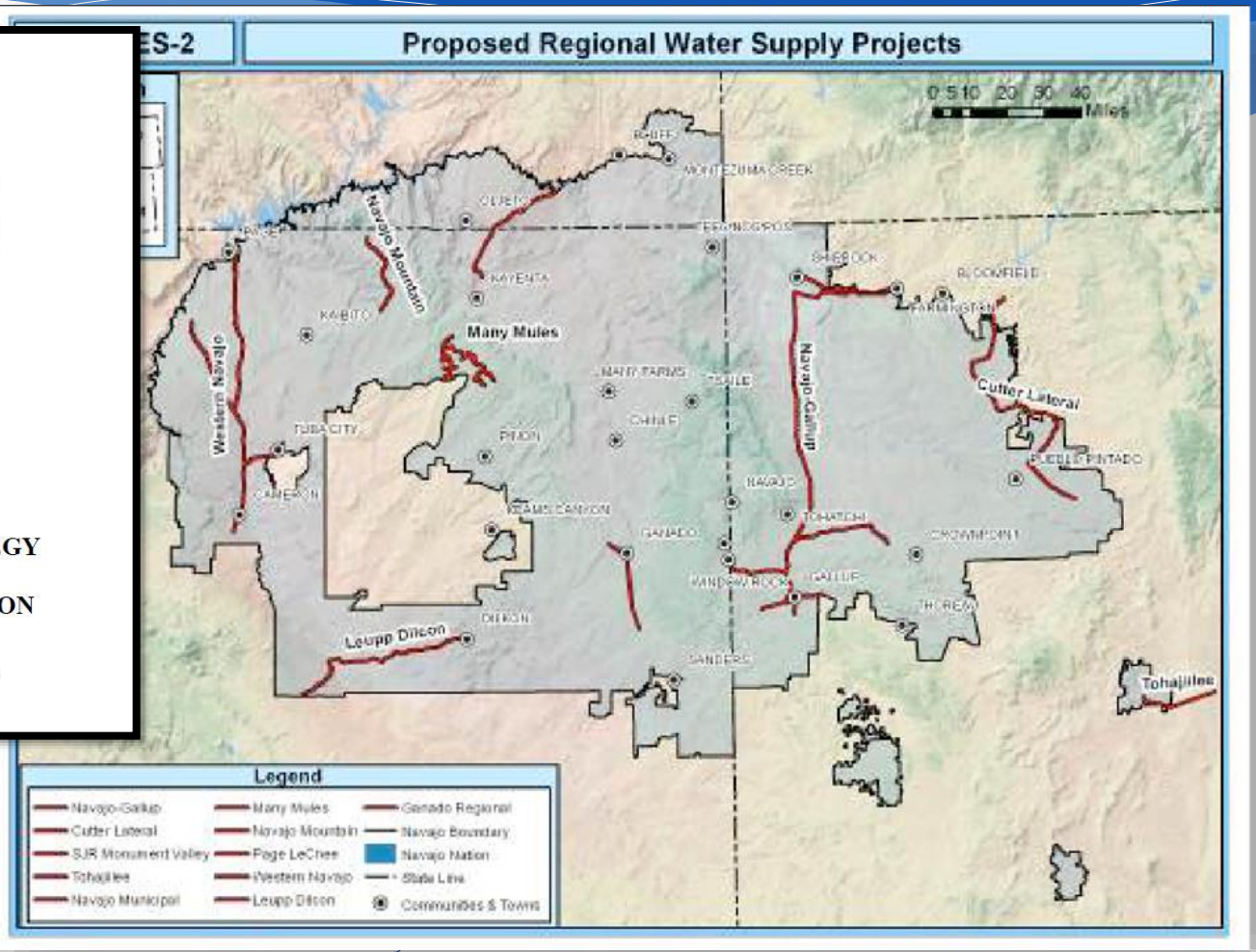
DRAFT

WATER RESOURCE

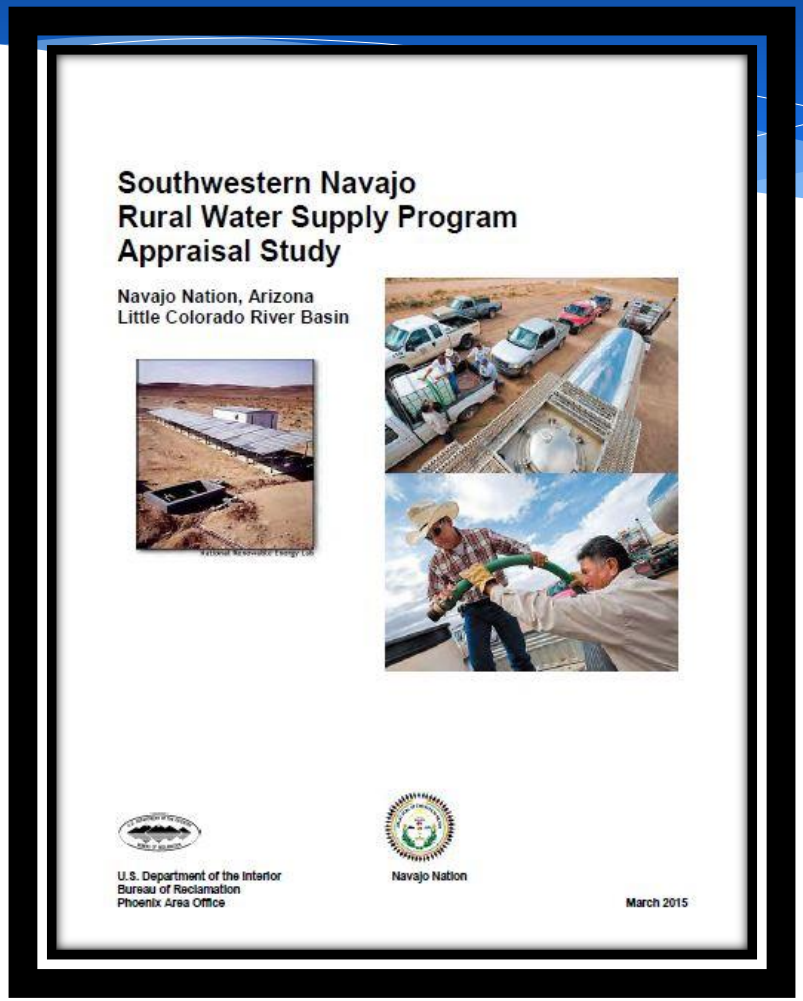
DEVELOPMENT STRATEGY

FOR THE NAVAJO NATION

NAVAJO NATION
DEPARTMENT OF WATER RESOURCES
July 2011



The Report


Southwestern Navajo
Rural Water Supply Program
Appraisal Study
Navajo Nation, Arizona
Little Colorado River Basin
U.S. Department of the Interior
Bureau of Reclamation
Phoenix Area Office
Navajo Nation
March 2015

The Study Area

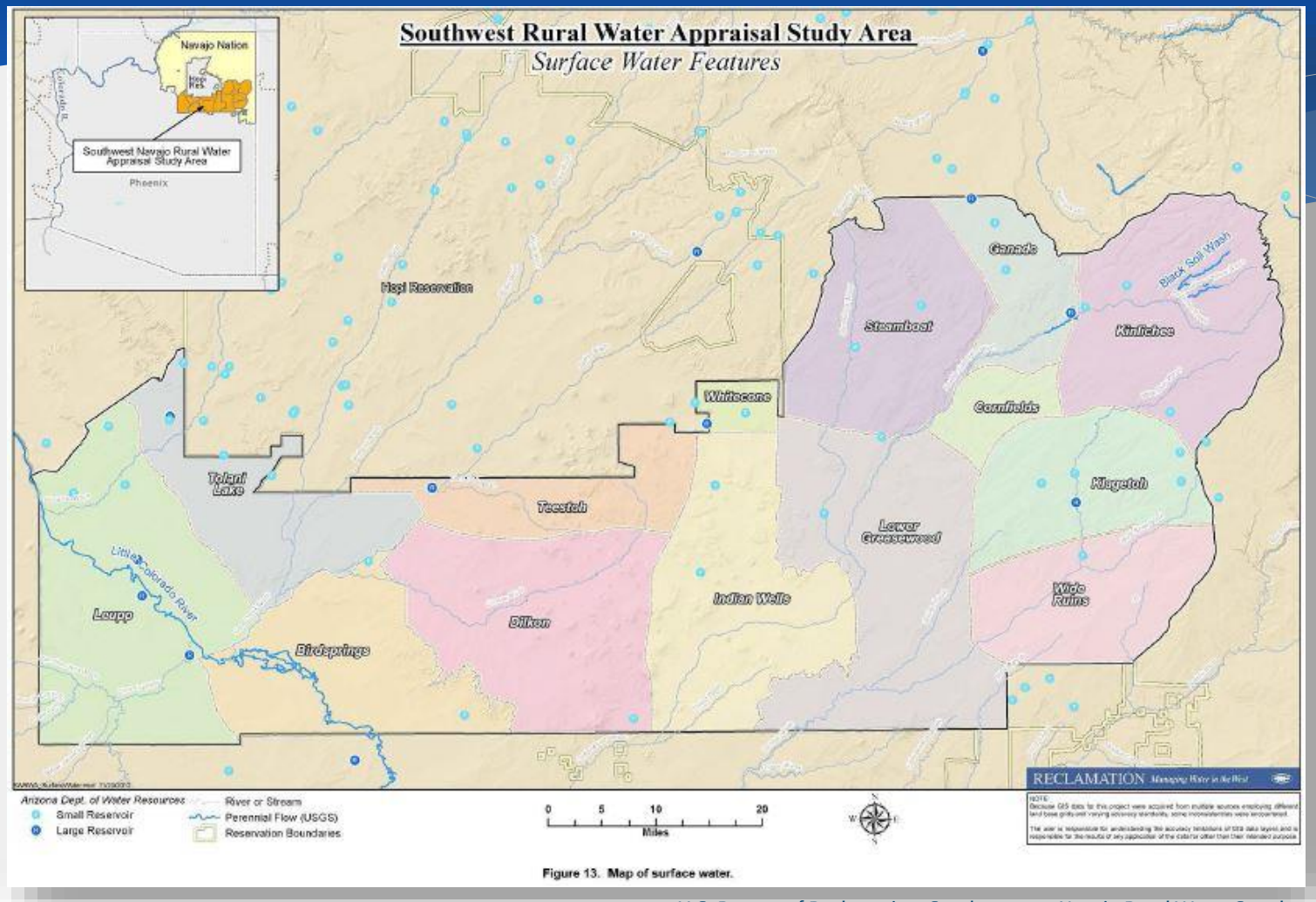
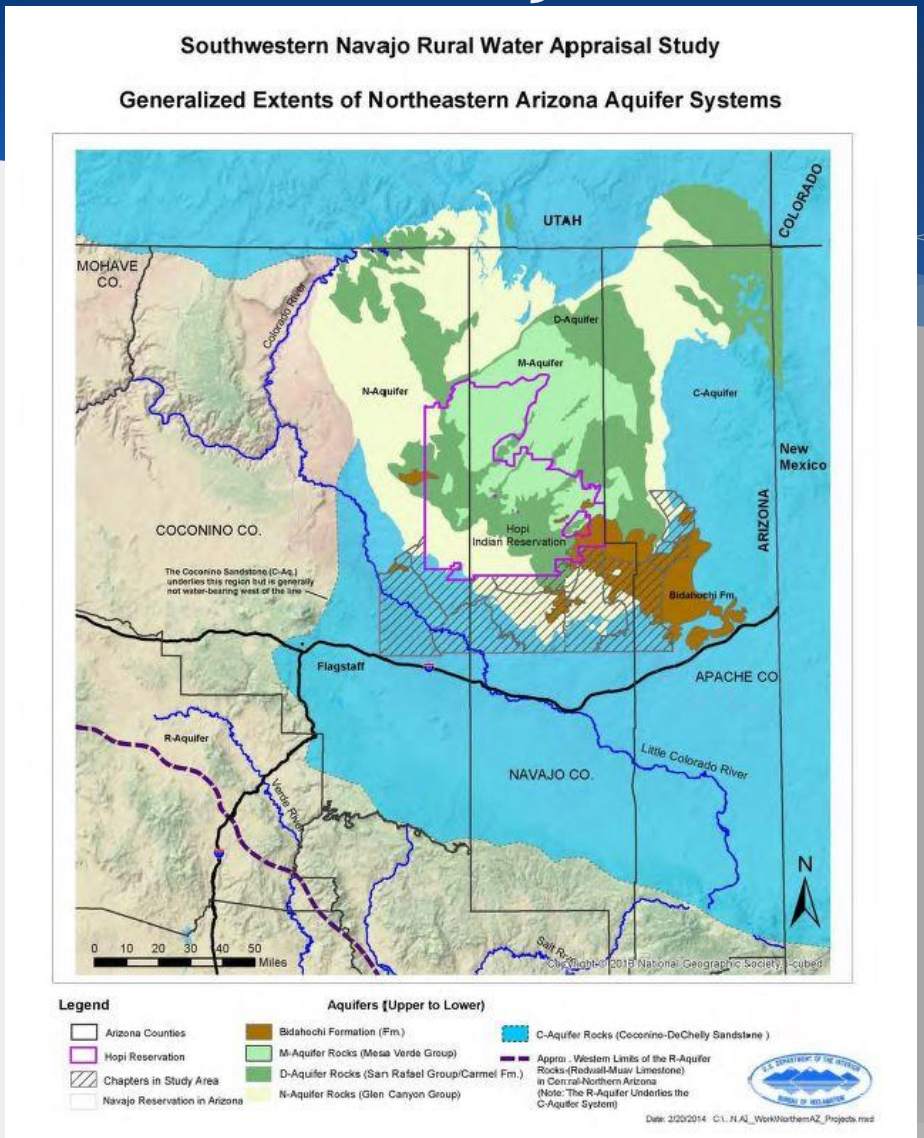


Figure 13. Map of surface water.

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

The Study Area



U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

The Study Area

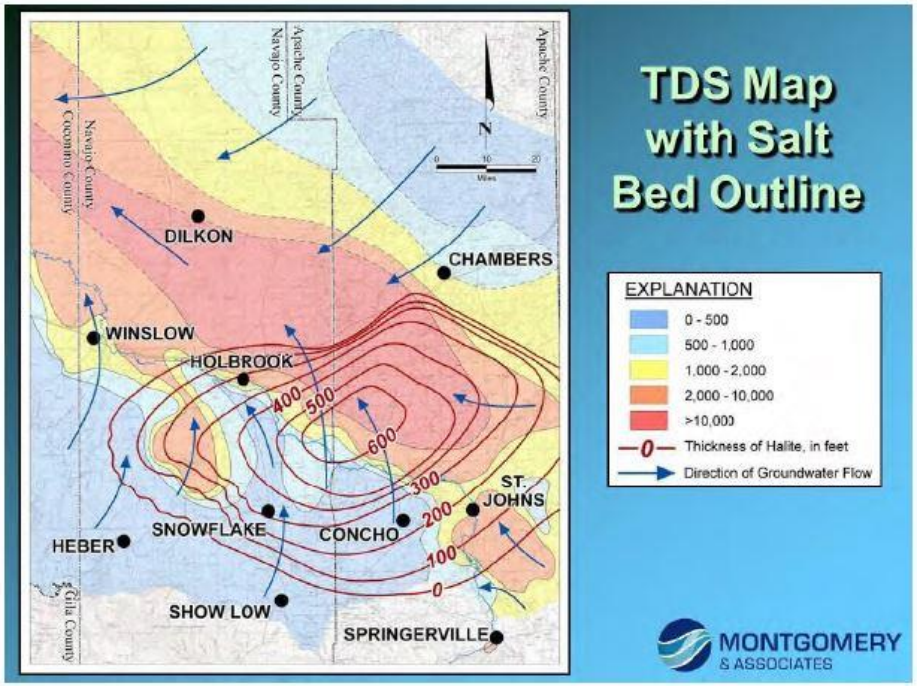


Figure 24. Levels of TDS in the C-Aquifer near the study area. The red lines show the thickness of the salt beds (halite) (Montgomery and Associates, 2011 [Presentation], all rights reserved).

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

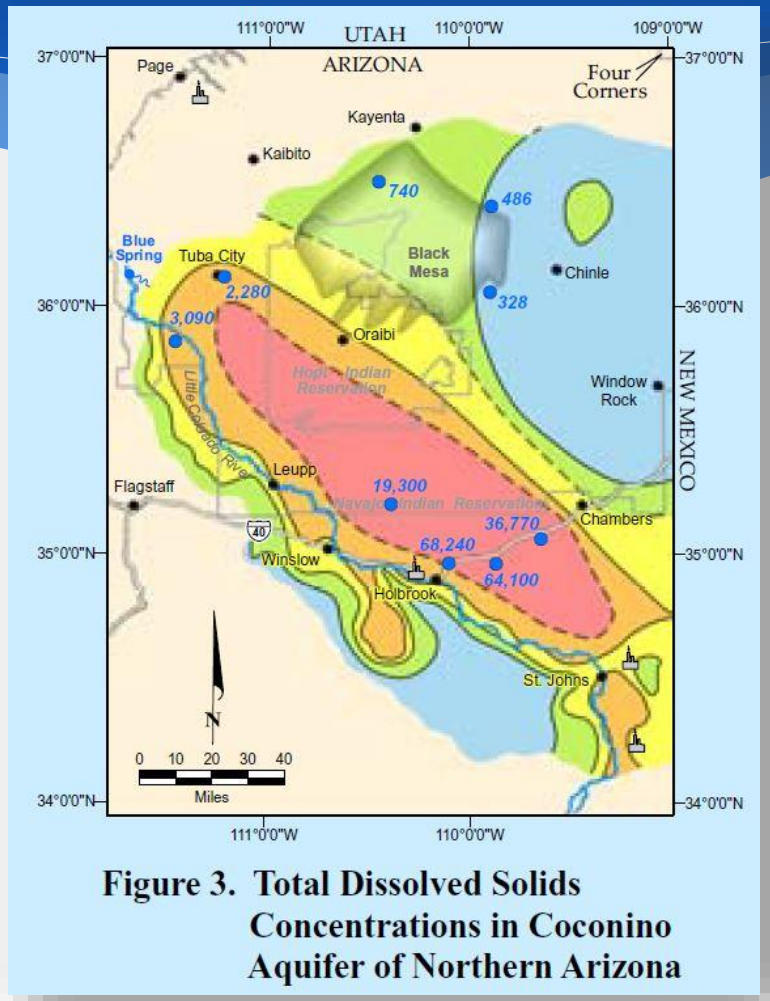


Figure 3. Total Dissolved Solids Concentrations in Coconino Aquifer of Northern Arizona

http://elmontgomery.com/wp-content/uploads/2016/10/salinityPoster.pdf

Location Issues/End User

Addresses a demand of 3,833 AFY in 2060. A 1.3% annual population growth was assumed, and 100 gallons per capita per day (including livestock and industrial).

End User **Households** without Access to Public Water Systems

White Cone: 132 (40%)

Indian Wells: 170 (85%)

Ganado: 27 (5%)

Lower Greasewood: 109 (31%)

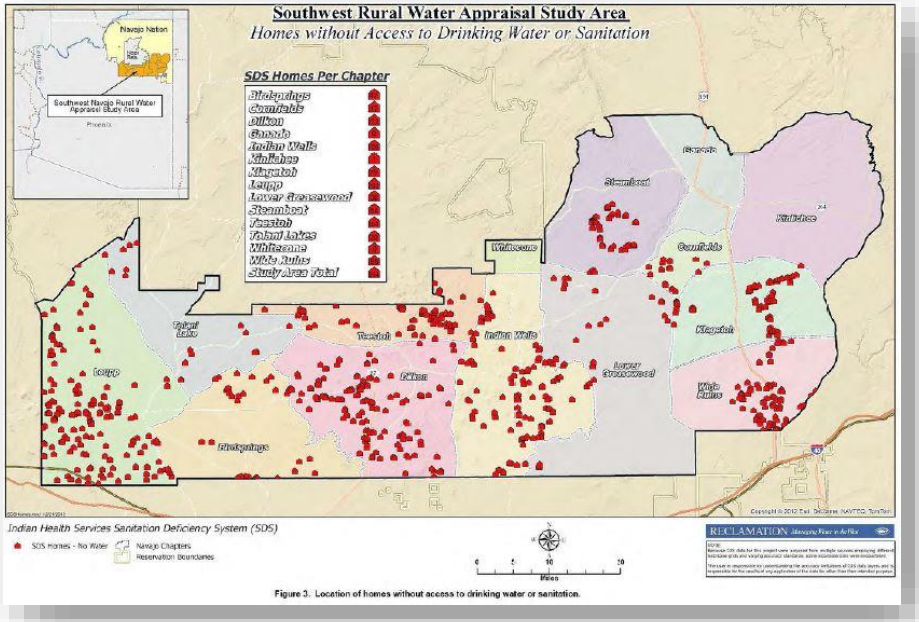


Figure 3. Location of homes without access to drinking water or sanitation.

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

Location Issues/End User

Table 7. Population and Population Projections Used for Water Demand Analysis

Chapter	1980 Census	2000 Census	2010 Census	2020 Projection	2030 Projection	2060 Projection
Kinlichee	966	1,404	1,610	1,832	2,085	3,071
Ganado	1,934	3,030	2,504	2,849	3,242	4,776
Cornfields	645	830	911	1,037	1,180	1,738
Klagetoh	844	1,037	909	1,034	1,177	1,734
Wide Ruins	1,248	1,225	1,095	1,246	1,418	2,089
Steamboat	1,399	1,668	1,226	1,395	1,587	2,339
Lower Greasewood	1,154	1,408	1,320	1,502	1,709	2,518
White Cone	913	1,383	1,284	1,461	1,662	2,449
Indian Wells	965	970	989	1,125	1,281	1,887
Dilkon and Teestoh	2,348	3,140	3,040	3,459	3,936	5,799
Tolani Lake	739	755	647	736	838	1,234
Bird Springs	718	829	795	905	1,029	1,516
Leupp	1,298	1,605	1,611	1,833	2,086	3,073
Total	**15,171**	**19,284**	**17,941**	**20,414**	**23,230**	**34,223**

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

Local Issues

* Families which haul water for domestic purposes spend the equivalent of $43,000 per AF compared with $600 per AF for a typical suburban water user region.
* The average distance to a well or water source is 10 miles one-way. Transportation costs users $205 per 1,000 gallons.
* The average daily consumption of water is roughly 10 gpcd.
* Current water systems do not meet residential demands (829.1 AFY verses 1,466 AFY)
* Pumping from the Pueblo Colorado Wash is not sustainable as the full demand exceeds the yield of the well field.

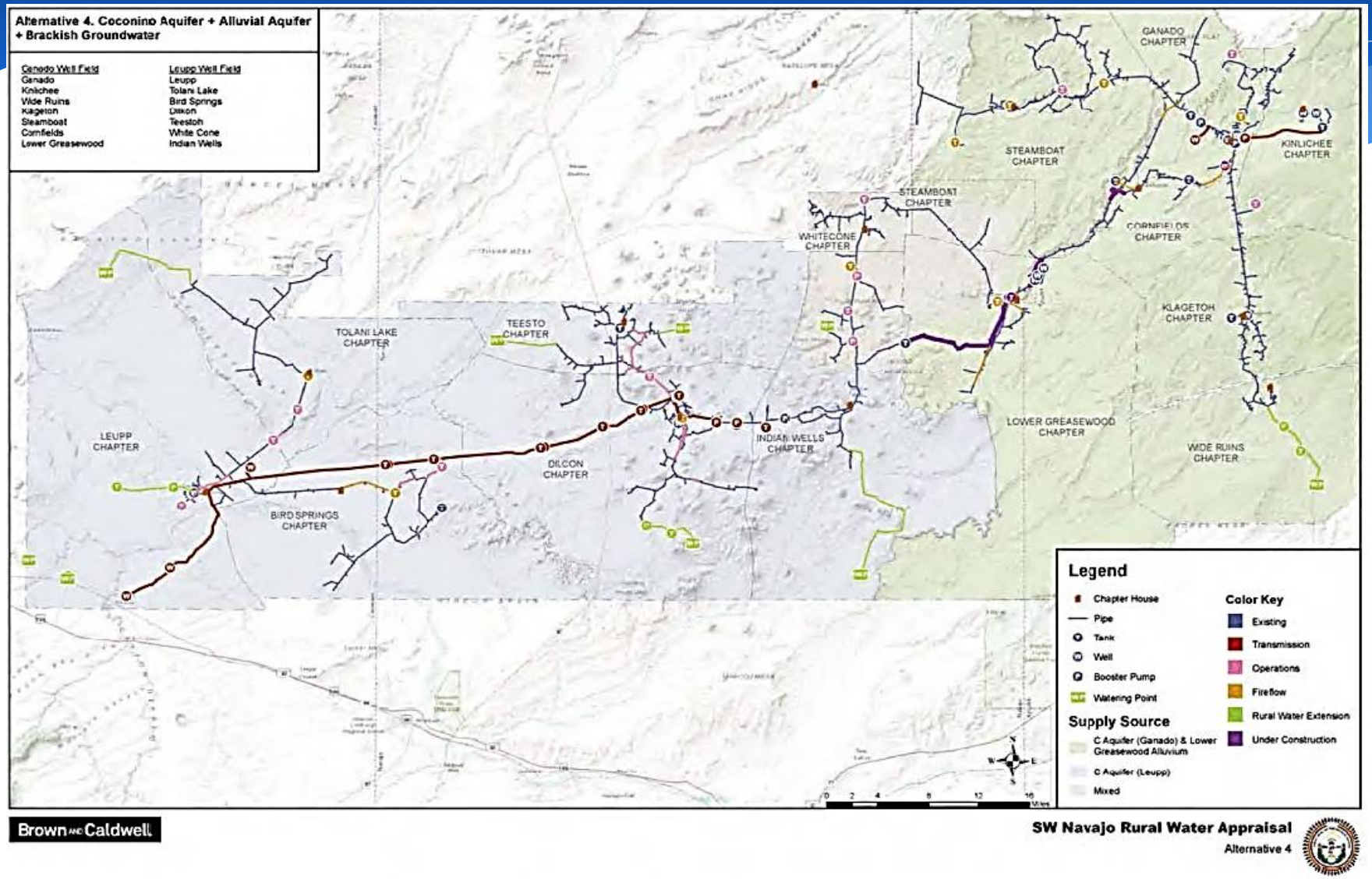
Figure 4. Drinking and using unsafe water. Clockwise from left to right: EPA sign on well notifying that water is unsafe to drink, testing an unsafe well, an elder siphoning water from a barrel labelled "corrosive," and filling drinking water containers from well labelled as unsafe for human consumption.

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

Alternative Projects Proposed

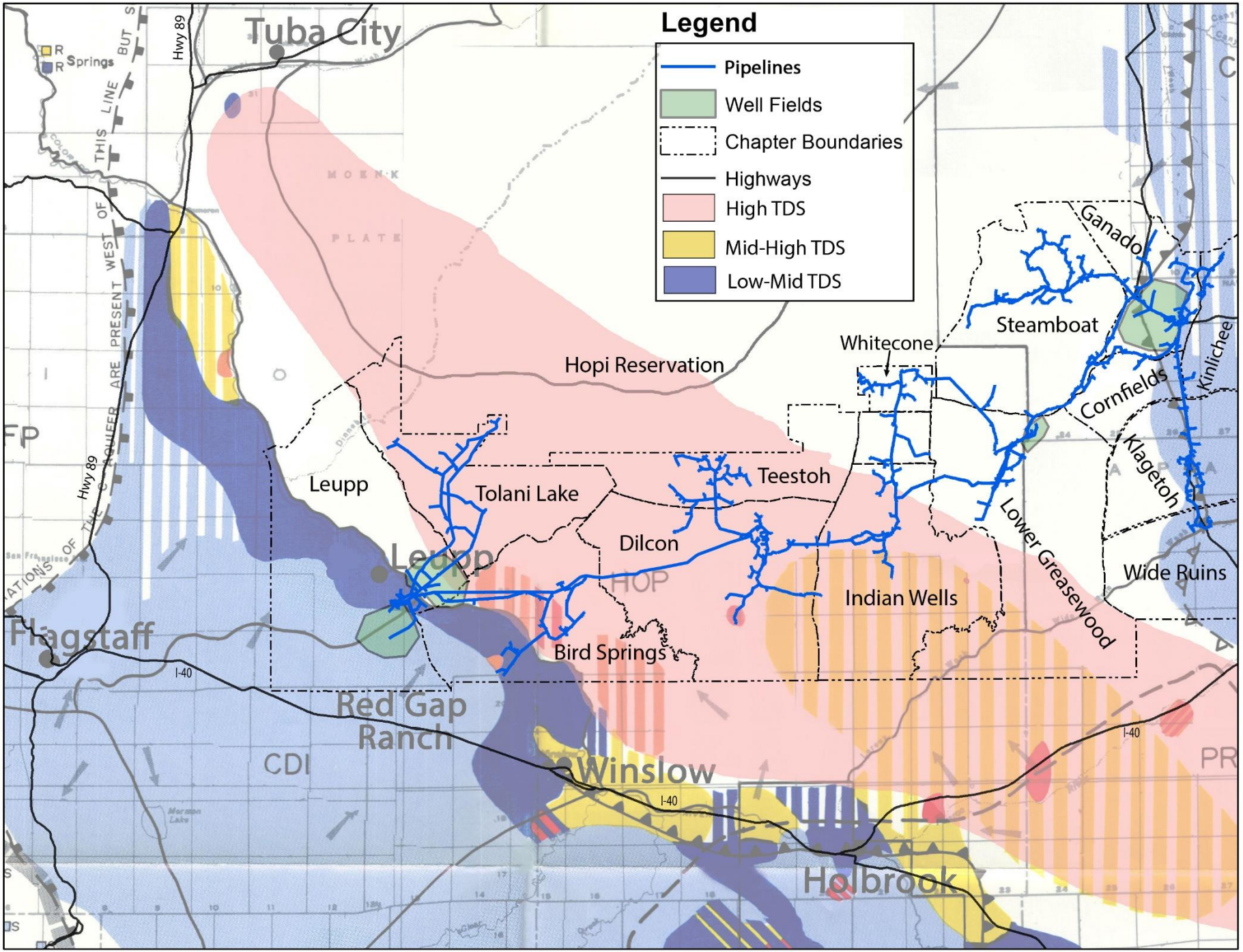
* **Brackish Groundwater (C-Aquifer in Ganado Chapter)**
  * Treatment of high salinity (5,000 – 10,000ppm) groundwater at 3,000 feet deep.
  * Eliminated from the study due to the high costs of construction and O&M for deep well extraction and treatment
* **Alternative #1: No Action**
* **Alternative #2: 50-50 C-Aquifer and Alluvial Groundwater**
  * Wells in Leupp and Ganado Chapters distribute water to White Cone and Indian Wells Chapters
* **Alternative #3: 60-40 C-Aquifer and Alluvial Groundwater**
  * C-Aquifer in Leupp and combination of C-Aquifer in Ganado with Alluvial Aquifer in Lower Greasewood Chapters
* **Alternative #4: 60-40 C-Aquifer, Alluvial, and Brackish Groundwater**

Alternative #4: C-Aquifer, Alluvial, and Brackish Groundwater



Brown AND Caldwell

SW Navajo Rural Water Appraisal
Alternative 4


Legend
Pipelines
Well Fields
Chapter Boundaries
Highways
High TDS
Mid-High TDS
Low-Mid TDS
Tuba City
Hopi Reservation
Leupp
Tolani Lake
Dilcon
Teestoh
Whitecone
Ganado
Steamboat
Cornfields
Kinlichee
Klagetoh
Lower Greasewood
Wide Ruins
Indian Wells
Bird Springs
Flagstaff
Red Gap Ranch
Winslow
Holbrook
Hwy 89
I-40

Sustainability of Supply

C-Aquifer Storage Capacity:

300 million acre feet (USGS)* to 413 million acre feet (ADWR)**.

Estimated amount of resource within the 14-Chapter study area: 40-50 million acre feet, with an average saturated thickness of 250-300 feet.

Black Mesa Environmental Impact Statement (OSMRE 2006): Withdraw of 11,600 AFY drawdown from 2000 to 2060 would show declines of 400 feet in Ganado and 50 feet in Leupp chapter.

Computed depletion from a USGS study (Hoffman et al. 2005) on the lower Clear Creek over a 51 year period of withdrawals followed by a 50 year period of no withdrawals were 0.4 cubic feet per second for 6,500 AFY and 0.5 cubic feet per second for 11,500 AFY

**http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/EasternPlateau/PlanningAreaOverview/Hydrology.htm

*https://pubs.usgs.gov/sir/2005/5277/sir_2005-5277.pdf

Land Availability/Cost

* Land cannot be acquired from the Navajo Nation without Congressional action; projects built on Navajo land require lease, permit, right-of-way, or other agreement and payment.
* Agreements may be of limited term but may be subject to renewal.
* Since recent regulatory change (2015), approval for right of way infrastructure (pipelines) has been expedited on Navajo lands.
* A project benefitting the tribe may not require consideration.
* Water projects on tribal land that do not benefit tribal members will not likely be approved.
* If land must be leased from the Navajo Nation, the cost of land to be leased is unknown.

Source: Appraisal Study & Stanley Pollack (personal communication)

Cost (Cap and O&M)

* Annual Operation and Maintenance: $2,414,000
* Estimated construction costs: $192 million (20-year repayment period assuming an interest rate of 3.375%)
* $2,000 - $3,000 AFY

Table 22. Total Construction and Annual OM&R Costs by Alternative (2010$)

Category of Cost	Alternative 2	Alternative 3	Alternative 4
Total Construction Costs	**$195,000,000**	**$195,000,000**	**$192,000,000**
Total Annual OM&R Costs	**$2,343,000**	**$2,419,000**	**$2,414,000**
Refurbishment	$213,881	$209,177	$209,177
Replacement	$1,483,278	$1,475,952	$1,471,214
O&M	$645,549	$733,989	$733,989

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

Cost (Cap and O&M)

* $94.9 million saved from transportation costs
* $236.6 million for total economic capital and O&M costs for project
* Would need roughly another $140 million in benefits to be economically feasible

Table 19. Net Benefits Comparison by Alternative (millions 2010$)

Project	Alternative 2	Alternative 3	Alternative 4
Benefits	$94.90	$94.90	$94.90
Costs	-$238.74	-$239.83	-$236.61
Net Benefits	**-$143.84**	**-$144.93**	**-$141.71**

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

Cost (Ability to Pay)

Table 25. Ability to Pay Results for EPA Threshold and Current Water Costs Methods

	EPA Threshold ATP Estimation Method			Current Cost ATP Estimation Method		
	Alternative 2	Alternative 3	Alternative 4	Alternative 2	Alternative 3	Alternative 4
Estimated ATP	$3,234,000	$3,234,000	$3,234,000	$9,156,000	$9,156,000	$9,156,000
Average Annual Project Cost Share	-$8,883,500	-$8,959,500	-$8,902,250	-$8,883,500	-$8,959,500	-$8,902,250
Net ATP	-$5,649,500	-$5,725,500	-$5,668,250	$272,500	$196,500	$253,750
Financially Feasible	No	No	No	Yes	Yes	Yes

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

Local Benefits

* Increasing water supply and quality reliability
* Reduce adverse impacts on the riparian habitats by relieving the water demands on the alluvial aquifers
* Extends water systems in such a way that the maximum round-trip distance for water retrieval would not exceed 10 miles.

Table 17. Estimated Economic Benefits per Household from Reduced Water Hauling in the Study Area (2010$)

	Without-Project Costs		With-Project Costs		With-Project Net Benefits
Cost	Cost per 1,000 Gallons	Annual Costs (14,400 gals/yr)	Cost per 1,000 Gallons	Annual Costs (14,400 gals/yr)	Annual Benefits
Transportation	$90.43	$1,302.19	$18.09	$260.45	$1,041.74
Water Purchase	$36.60	$527.04	$36.60	$527.04	$0.00
Container	$4.51	$64.94	$4.51	$64.94	$0.00
Opportunity Cost of Time	$73.70	$1,061.28	$19.29	$277.80	$783.48
Total	**$205**	**$2,955**	**$78**	**$1,130**	**$1,825**

U.S. Bureau of Reclamation; Southwestern Navajo Rural Water Supply Program; March 2015

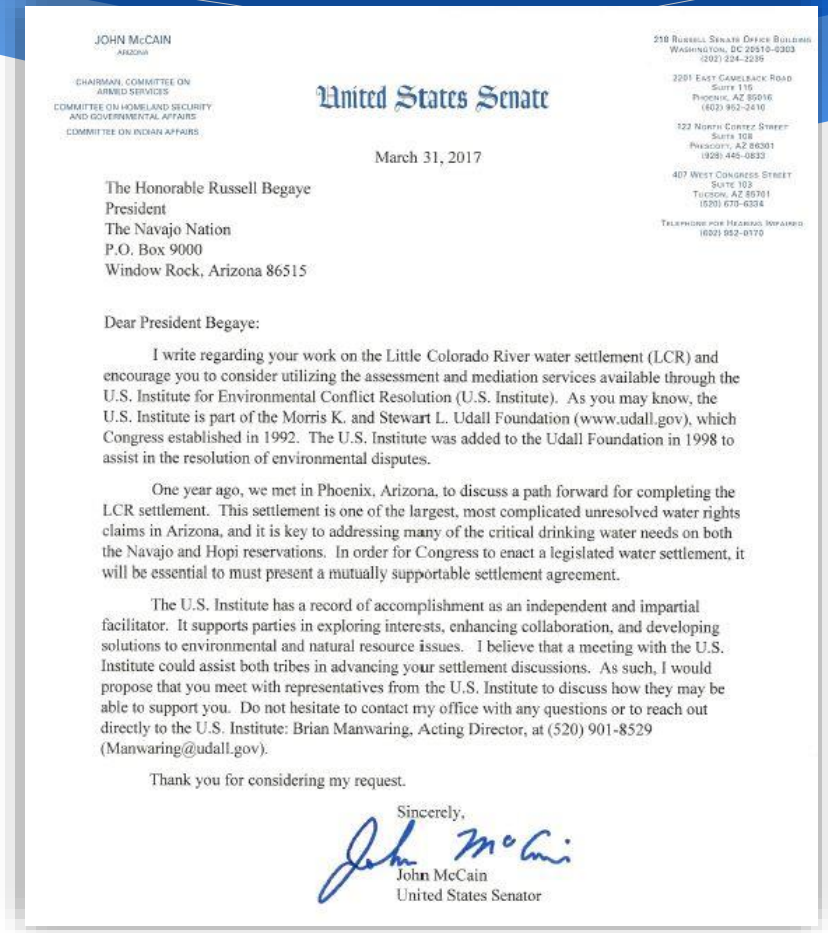
Regulatory/Legal Issues

* Questionable whether the Navajo Tribal Utility Authority's accepts the use of a brackish water supply and its compatibility with the Indian Health Service Sanitary Deficiency .

* Alternative project is the product of 10+ years of investigations associated with water rights negotiations and public water development. Local Chapters, water managers, federal water development entities have collaborated with the Navajo Nation Government. Various assumptions and project concepts have evolved in the negotiations since 1979, **yet there is a lack of consensus regarding many of the assumptions used in this appraisal study. An effort to resolve any potential conflicts and reach consensus would be undertaken during the feasibility stage.** (4.2)

Regulatory/Legal Issues

* Senator John McCain encouraged Navajo Nation President Russell Begaye to utilize the assessment and mediation services available through the U.S. Institute for Environmental Conflict Resolutions to resolve the Lower Colorado River settlement.



JOHN McCAIN
ARIZONA

CHAIRMAN, COMMITTEE ON ARMED SERVICES
COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS
COMMITTEE ON INDIAN AFFAIRS

United States Senate

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Telephone for Hearing Impaired
(602) 952-0170

March 31, 2017

The Honorable Russell Begaye
President
The Navajo Nation
P.O. Box 9000
Window Rock, Arizona 86515

Dear President Begaye:

I write regarding your work on the Little Colorado River water settlement (LCR) and encourage you to consider utilizing the assessment and mediation services available through the U.S. Institute for Environmental Conflict Resolution (U.S. Institute). As you may know, the U.S. Institute is part of the Morris K. and Stewart L. Udall Foundation (www.udall.gov), which Congress established in 1992. The U.S. Institute was added to the Udall Foundation in 1998 to assist in the resolution of environmental disputes.

One year ago, we met in Phoenix, Arizona, to discuss a path forward for completing the LCR settlement. This settlement is one of the largest, most complicated unresolved water rights claims in Arizona, and it is key to addressing many of the critical drinking water needs on both the Navajo and Hopi reservations. In order for Congress to enact a legislated water settlement, it will be essential to must present a mutually supportable settlement agreement.

The U.S. Institute has a record of accomplishment as an independent and impartial facilitator. It supports parties in exploring interests, enhancing collaboration, and developing solutions to environmental and natural resource issues. I believe that a meeting with the U.S. Institute could assist both tribes in advancing your settlement discussions. As such, I would propose that you meet with representatives from the U.S. Institute to discuss how they may be able to support you. Do not hesitate to contact my office with any questions or to reach out directly to the U.S. Institute: Brian Manwaring, Acting Director, at (520) 901-8529 (Manwaring@udall.gov).

Thank you for considering my request.

Sincerely,

John McCain
United States Senator

Questions?

Arizona Water Initiative

Coordinator:

Zacary Richards
zbrichards@azwater.gov
(602) 771-8311